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BULLETIN

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OF THE

AMERICAN PHYSICAL SOCIETY

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PROGRAMME OF THE

STATE COLLEGE MEETING

AT

STATE COLLEGE

PENNSYLVANIA

June 18 and 19, 1943

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The American Physical Society

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BULLETIN

OF THE

AMERICAN PHYSICAL SOCIETY

STATE COLLEGE MEETING, JUNE 18–19, 1943

THE **255th meeting of the American Physical Society** will be held at State College, Pennsylvania, on Friday and Saturday the 18th and 19th of June, 1943. The American Association of Physics Teachers holds a meeting which begins with contributed papers on the Thursday evening at 7:30, and continues throughout the Friday. Their Friday programme commences at nine in the morning with a symposium "Physics in War Training Programmes" to which we are cordially invited. Ours commences on Friday at twelve noon with a lecture on Cosmic Rays by W. F. G. Swann. We continue jointly at 2:30 P.M. with a symposium "The Role of Physics in the Post-War Period." The dinner of the two societies is set for Friday evening, and will be followed by a lecture by F. C. Whitmore, "Organic Chemistry for Physicists." Our programme continues throughout Saturday with invited papers pertaining to Chemical Analysis by Physical Methods, and with contributed papers. All sessions, excepting one of the two on Saturday afternoon (and perhaps the lecture of Dean Whitmore) are to be held in Room 117 of the Physics Building. The other of the Saturday-afternoon sessions will be held in Room 119 of the same building.

State College is reached by bus from Lewistown or Altoona, both on the main line of the Pennsylvania Railroad. The service from Lewistown is the more frequent, all daytime trains after twelve noon being met by busses. The busses from Altoona leave at 12:50 P.M. and 5:50 P.M. reaching State College in about an hour and a half; they may be boarded at Pittsburgh at 8:15 A.M. and 1:35 P.M., respectively. A (Greyhound) bus direct to State College leaves New York at 7 A.M. Certain main-line trains make connections at Altoona with trains to Bellefonte, whence State College is reached by Johnston bus. Those coming from the North should take the Pennsylvania Railroad line to Lock Haven or Williamsport, and proceed by Johnston bus to State College.

All of the information usually printed in this place about hotels, and about the hour and location of the dinner, is omitted on this occasion; for the Local Committee is taking entire charge of all these matters. **Take note of the printed form on the inside back cover page of this Bulletin, which must be mailed by everyone wishing to be assured of accommodation.** Only a very few rooms will be available for those who turn up without advance notice. A registration desk will be set up in the Physics Building of the College from Thursday afternoon onward, and members and guests should present themselves at this desk as soon as they arrive.

The **Council** of the American Physical Society will meet on Friday at 5 P.M. in a room to be indicated to the members thereof by later communication (failing which, they must ask at the registration desk).

Belated summons-cards. The preliminary announcements or summons-cards for this meeting were entrusted to a branch postoffice in New York City, some on May first and the rest on May third. Nevertheless it transpires that some of our members did not receive them in time to

prepare abstracts, and may indeed not have received them at the time of this writing. Inquiry is being made at the post-office. The Secretary expresses his regret at this contretemps, which may have prevented many from presenting papers at this meeting.

Subsequent meetings of the American Physical Society are scheduled for Stanford University, California, on Saturday, July 10, 1943; and for Chicago, Illinois, on Friday and Saturday, November 26 and 27, 1943.

Geneeal Rules Relating to Papers

By vote of the Society on December 27, 1940, no paper may be accepted for presentation at any meeting of the Society unless the title and an abstract of the paper are delivered to the office of the American Physical Society not later than the closing date stated in the printed call for the meeting.

The time allowed for the oral presentation of a contributed paper is ten minutes at most.

When two or more papers are contributed by the same member, all but one are placed on the "supplementary programme." (A paper by two or more members is credited to the one first named in its title.) For each paper on this programme the Secretary indicates a session at which it may be presented. The presiding officer at this session may call for it when the other papers are completed, may require that it be given in shortened form, or may read it by title.

Titles and abstracts of the papers to be presented are given in the following pages. Proofs of these abstracts have not been submitted to the authors. After submission of proof the abstracts will be published in an early number of *The Physical Review*.

Karl K. Darrow, *Secretary*,
American Physical Society,
Columbia University, New York, New York

PROGRAMME

FRIDAY MORNING AT NINE O'CLOCK

Symposium of the A.A.P.T.

Physics in War Training Programmes

FRIDAY AT TWELVE NOON

Cosmic Rays: W. F. G. SWANN, *Director, Bartol Research Foundation*

FRIDAY AFTERNOON AT 2:30 O'CLOCK

Symposium of the A.P.S. and A.A.P.T.

The Role of Physics in the Post-War Period

Some Problems Facing Physicists. R. C. GIBBS, *Cornell University.*
Needs in Research. G. P. HARNWELL, *University of Pennsylvania.*
Physics in Industry. R. BOWLING BARNES, *American Cyanamid Company.*

FRIDAY EVENING

(hour and place to be announced)

Dinner of the American Physical Society and American Association of Physics Teachers

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FRIDAY EVENING AFTER THE DINNER

Organic Chemistry for Physicists: F. C. WHITMORE,

Research Professor of Organic Chemistry, Dean of the School of Chemistry and Physics, State College, Pennsylvania

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SATURDAY MORNING AT 9:30 O'CLOCK

Modern Spectrochemical Analysis. E. K. JAYCOX, *Bell Telephone Laboratories* (35 minutes.)
Physical Methods of Analysis and Control in the Chemical Industry. NORMAN WRIGHT, *Dow Chemical Company* (35 minutes).
Identification of Certain Organic Compounds. M. L. WILLARD, *Pennsylvania State College* (15 minutes).
An Addition to the Analytical Application of Raman Spectra. R. J. PFISTER, *Pennsylvania State College* (15 minutes).
Selective Dispersion: Physical Phenomena used in Quantitative Organic Analysis. A. F. KIRKPATRICK, *Pennsylvania State College* (15 minutes).
Magneto-Optic Rotation in Solutions. C. E. WARING, *Brooklyn Polytechnic Institute* (35 minutes).

Saturday Afternoon at Two O'Clock

Invited Papers

A Summary of the Work on Low Temperature Heat Capacities at the Pennsylvania State College during 1942–1943. J. G. Aston, G. J. Szasz, H. L. Fink and M. L. Sagenkahn, *Pennsylvania State College* (15 minutes).

Some Preliminary Investigations on Dehydration of Fruits and Vegetables with Infra-Red Energy. J. E. Nicholas, *Pennsylvania State College* (15 minutes).

Contributed Papers

1. The Viscosities of Pure Hydrocarbons and Lubricating Oils at Various Temperatures. M. R. Cannon and J. M. Geist, *Pennsylvania State College.*—Viscosity data were obtained for fifty-five hydrocarbons in the gasoline range at 0°C, 20°C, and 40°C. The measurements were made with modified Ostwald viscometers with water baths for temperature control. The viscosity-temperature behavior of the hydrocarbons followed the equation $\eta = Ae^{-B/RT}$. With this equation, the viscosities of the hydrocarbons may be calculated between 0°C and 40°C with a deviation of less than one percent. Some trends in the viscosity behavior of the measured hydrocarbons were noted. Among the octanes, the more compact molecules had the highest viscosities and viscosity-temperature coefficients. For the hydrocarbons which had approximately the same viscosities at 40°C, the alkylcyclopentanes had the lowest viscosity-temperature coefficients. They were followed by the alkylbenzenes, the alkylcyclohexanes, and the paraffins in that order. Vapor baths with automatic pressure regulation, which may be used for temperature control between 100°F and 500°F, were constructed. However liquid baths were preferred up to 210°F. The viscosities of three lubricating oils were determined at 100°F and 210°F using water baths, and at 300°F, 400°F, 450°F, and 500°F using the vapor baths. Their viscosity-temperature behavior did not follow the above equation. The measured viscosities of the lubricating oils were compared with values read from A. S. T. M. Viscosity-Temperature Charts. Above 300°F the chart values were always higher than the measured viscosities, by as much as ten percent at 500°F.

2. Solvent Extraction. K. A. Varteressian, *Pennsylvania State College.*—Solvent extraction is steadily taking its place as a unit operation in chemical engineering. Like most of them, it is primarily physical in nature. In an endeavor to understand its theory and practice, solvent extraction may be divided into the following: (a) equilibrium relationships (b) methods of operation (c) design of equipment and (d) applications in various industries. The art and science of extraction has profited a great deal by analogy with the more widely used and discussed unit operation of distillation; thus the concepts of similarity between heat and solvent and between vapor pressure and osmotic pressure have aided in organizing the subject matter, especially with regard to solvent economies, equilibrium relationships and efficiency factors. On the other hand, analogy with the unit operation of absorption has been of assistance in formulating rate and capacity equations and a view of extraction mechanism. Extraction with solvent is an effective tool in the separation of complex solutions into their component parts. It is particularly adapted to the segregation of substances having high boiling points and susceptible to decomposition. The analysis of residual petroleum oils by means of extraction with acetone at room temperature is an illustration of the numerous potentialities of this unit operation.

3. An X-Ray Study of Brasses Formed by the Interdiffusion of Copper and Zinc Deposited on Glass by Evaporization. Arthur A. Burr, H. S. Coleman, H. L. Yeagley and W. P. Davey, *Pennsylvania State College.*—By using the technique developed by Coleman and Yeagley, alloys were made by the interdiffusion of films of copper and zinc deposited on glass microscope slides by vaporization methods and x-ray investigations carried out. Data were obtained by means of the standard photographic powder method and by means of the Penn State Automatic X-Ray Spectrometer. Metal films used were of the order of 6×10^{-5} cm in thickness. (1) It is shown that the metal films formed on glass by vaporization and the resulting alloys formed by diffusion have the same crystal structure as the bulk metal. (2) A series of samples in the beta brass range were subjected to heat treatment at 198°C for varying lengths of time. Their diffraction patterns show that formation of any higher phase by diffusion involves temporary existence of all the other copper-zinc phases as intermediate stages. (3) Diffraction patterns recorded by the Automatic Spectrometer show orientation in the films. This gives experimental support to a proposed picture of the nature of phase changes during diffusion based on calculations from the lattice parameters. Techniques and procedure developed in this work suggest a method of determination of constitution diagrams and diffusion rates at low temperatures.

4. Tables of Intensity Ratios for Scattered Molecular Beams. John K. Wood, *Pennsylvania State College.*—In the interpretation of data of experiments on the scattering of molecular beams by molecular clouds, graphs of a non-integrable function were required. The beam intensity ratio

before and after scattering is a function of the temperatures of the beam molecules and of the temperature of the scattering cloud of molecules thus giving a family of curves of intensity ratios against one temperature function, the other being a variable parameter. The integral contains a term determined by a wave mechanical consideration of the problem of collisions and does not yield a simple closed solution because of this factor. The trapezoid rule for numerical integration was used in preference to Simpson's rule since it gave a smaller error to the numerically summed integral when the molecular cloud temperature was zero. The theoretical value of the integral at this point of no scattering is 1.000. Errors were taken at this point because on integrating again with a smaller interval of the dependent variable the first point showed the largest deviation from the more accurate integration. The tables have a temperature range which will cover most experiments using Li, Na and K.

5. Further Facts Concerning the Magnetic Current. FELIX EHRENHAFT, *New York City.*—The hypothesis of the electric current was founded chiefly upon three facts: The existence of electric ions, the decomposition of water (electrolysis), the circulation of the single magnetic pole around the constant electric current. Now those three facts have been observed in magnetism as well: the existence of magnetic ions, the decomposition of water through the magnet (magnetolysis), the circulation of a single electrostatic charge around the constant magnetic current. In the microscope one observes that different gas bubbles as well as solid particles move in circles around the axis of the magnet simultaneously in opposite directions. Each of them reverses its direction of motion with the reversal of the magnetic field. The bodies carry positive or negative electrostatic charges. The existing laws of electrodynamics (Biot-Savart, H. A. Lorentz) cannot explain the new facts because the electrostatic charges in question are resting ones, etc. Just as the line integral of the magnetic force defines the intensity of the electric current (ampere), the line integral of the electric force defines the intensity of the magnetic current. Electricity and magnetism represent an indivisible union, reaching far above the union established by Faraday, Maxwell, and Hertz. The electrodynamic equations must be extended to include the term of the magnetic current. These theses will be illustrated by microphotographs of the experiments.*

* The experiments can be seen at C. Zeiss Inc., New York City.

SATURDAY AFTERNOON AT TWO O'CLOCK

(Room 119, Physics Building)

6. Use of a Mass Spectroscope in Artificial Radioactive Assignments. W. M. SCHWARZ AND M. L. POOL, *Ohio State University.*—At a number of places throughout the array of stable and artificial radioactive isotopic positions unequivocal assignments of activities to definite mass numbers are very difficult or impossible even with the aid of various bombarding particles and exacting chemistry. Consequently a modified Nier type mass spectrograph was adapted for use with artificial radioactive sources. The source of ions was a high frequency spark between solid electrodes which previously had been made radioactive. Very strong and highly concentrated activities are needed for satisfactory operation. The method was checked with the 12-hour radioactive copper period. Zirconium bombarded with deuterons yielded two periods of 23 hours and 18 days which have in addition to previously reported characteristics gamma-rays energies of 1.1 and 0.97 Mev, respectively.

7. Radioactivities in Barium Obtained from Cesium. KATHERINE E. WEIMER, M. L. POOL, AND J. D. KURBATOV, *Ohio State University.*—Additional observations on the artificial radioactivies induced in barium indicate that a very long period of several months is obtained by the Cs+*d* reaction in addition to the previously reported period of 38.8 hours. The long period emits x-rays characteristic to the cesium region as well as gamma-rays. Repeated purifications identify this long period chemically as barium. After several months following a bombardment chemical separations of the barium fraction from bombarded cesium yielded no activity. Therefore this period seems best assigned to Ba^{133}. The previously reported 14.2-day period obtained from Cs+*d* was not observed from Hilger spectroscopically pure cesium. Proton bombardment of cesium yielded a single period of 38.8 hours also assigned to Ba^{133}.

8. Determination of Nuclear Moment of Rubidium by Resonance Radiation. RALPH ATHERTON, *Miami University. (Introduced by R. L. Edwards.)*—Radiation of λλ4201.8A and 4215.56A from a hydrogen-rubidium discharge tube was focused on a resonance chamber containing distilled rubidium. Resonance radiation from this chamber was photographed through Wollaston and Nicol prisms. The percentage of polarization was calculated from these plates and the results compared to theoretical calculations based upon nuclear moment assignments for rubidium made by Jackson. The agreement seemed to be well within experimental error.

9. Sensitized Fluorescence and Tesla Discharge Spectra of Chromium Vapor. J. G. WINANS AND W. J. PEARCE, *University of Wisconsin.*—The Tesla discharge and sensitized fluorescence spectra of chromium vapor have been obtained with the simplified procedure that was followed for lead and indium.[1] Electrolytic metallic chromium was

crushed to a powder and inserted in the quartz tubes before evacuation. The completed tubes contained only mercury and powdered chromium. Spectra were obtained with different mercury pressures from about 0.1 to 15 cm. The temperature was kept as high as possible without collapsing the quartz tube. About fifty chromium lines have been identified in the Tesla discharge spectra at medium to high mercury pressures. Six lines (the two resonance triplets at 3600 and 4300) have been obtained in sensitized fluorescence. No action of selection rules for excitation of Cr by collision of the second kind is indicated by results so far obtained.

[1] J. G. Winans, Francis Davis, and Victor Leitzke. Pb Abstract, Phys. Rev. **55**, 1126 (1939). In Abstract, Phys. Rev. **57**, 70 (1940).

10. Exterior Ballistics of Small Arms Ammunition. RALPH HOYT BACON, *Frankford Arsenal, Philadelphia, Pennsylvania.*—Previous measurements of the time of flight and of the velocity of small arms bullets have involved firing through two or more screens of some kind. These screens, of course, affect the flight of the bullet, so that it was seldom feasible to fire through more than three screens at once. Furthermore, in order to obtain velocities and times of flight as functions of the distance, it was necessary to fire a few bullets through a set of screens placed at some chosen distances, and then to fire another group of bullets through another set of screens at another set of distances, and then try to make the sets of results agree. The equations thus obtained are generally quite complicated. However, a bullet in flight carries a small electrostatic charge. The arsenal has developed apparatus for detecting the passage of these charged bullets through the plane of a loop of thin wire, without interfering with the flight of the bullet. By firing bullets through a series of such loops, and recording the transit of the bullets on a suitable chronograph, the following remarkably simple equation was obtained for velocities between 2000 and 3000 feet per second: $dv/dt = -kv^{3/2}$.

11. Isobary—A Criterion for the Stability of the Lithosphere. ROSS GUNN, *U. S. Naval Research Laboratory, Washington, D. C.*—A quantitative investigation is made of the influence of a strong elastic lithosphere on departures from isostasy. Isostasy is shown to be a special case of a more general principle that may be called the principle of isobaric equilibrium. This principle which expresses the condition for vertical equilibrium is formulated quantitatively both in terms of the resultant vertical stresses in the lithosphere and in terms of measurable gravity anomalies. Employing the principle, a stress function may be determined that permits an estimate of the fraction of the uniform superposed load actually carried by the lithosphere. By applying this method, it is found that even for the central region of a block load to be in substantial isostatic adjustment (96 percent), the linear dimension of the load must approximate 330 km, a value more than six times that often assumed. The deformed figures of the lithosphere for certain special types of load have been worked out together with the stress function that measures both the gravity anomaly and the resultant vertical stress. The resulting distributions of displaced mass that compensate for various types of earth features are found to be not at all like the distributions usually assumed in isostatic reductions.

12. Heat Conduction in Blocks and Cylinders. C. B. POST, *The Carpenter Steel Company, Reading, Pennsylvania.*—Solutions of the heat-conduction equation are discussed for computing the rates of cooling at 1300°F during quenching in various finite sections such as cylinders, bars and blocks. The proposed method utilizes simple combinations of the temperature functions for the quenching of cylinders of infinite length and slabs for which tables are available. These calculated rates of cooling in finite sections are used to determine hardness contours in hardened steel blocks and cylinders. Data are presented showing the comparison of calculated and experimental hardness contours in various steel shapes.

13. Supersonic Measurements in Gases. W. H. PIELEMEIER, *Pennsylvania State College.*—A number of previous investigations of the velocity and the absorption of sound waves in gases were reviewed. Curves are shown for V_0, the velocity of low frequency and of V_∞, the velocity of high frequency sound waves in dry CO_2 as a function of temperature from 0 to 100°C. Another set of curves shows how f_m, the frequency producing maximum absorption per wavelength depends on the water vapor concentration in the CO_2 at approximately one atmosphere pressure. Evidence is presented for *two* distinct relaxation times for each given concentration. Most of this evidence is found in the published work of Knudsen and his students and in our data. A number of investigators have doubted the existence of two distinct relaxation times in CO_2. Acetaldehyde[1] has recently been investigated and was found to have three distinct relaxation times. Our measurements with helium of high purity show that the specific heat agrees well with the theoretical value and that the absorption agrees better than earlier results. Byers' work in this laboratory with carbon tetrafluoride furnishes a reliable value for the specific heat and for the relaxation time of CF_4.

[1] Alexander and Lambert, Proc. Roy. Soc. **179**, 499 (1942).

14. Measuring Small Increments of Length by Hydraulic Michelson Interferometer. C. G. STERGIOPOULOS, F. H. NADIG, AND J. L. BOHN, *Temple University.*—By applying hydraulic magnification to move one of the mirrors of the Michelson interferometer, increments of length of the order of 10^{-7} cm are detected. The apparatus consists essentially of two vertical cylinders of different diameters, partially filled with mercury and connected at the lower ends. Each is fitted with a freely moving plunger. Displacement of the large plunger is detected by the interferometer, one of whose mirrors is fixed to the smaller plunger. To verify the magnification as given by the dimensions of the apparatus, readings on this apparatus were compared with readings on a conventional Michelson interferometer. The instrument was used in the measurement of magnetostriction but can be applied to other small changes in length or may be used as a surface roughness indicator.

To Be Read By Title

15. The Application of Multiplier Photo-Tubes to Quantitative Spectrochemical Analysis. E. A. BOETTNER, *Wyandotte Chemicals Corporation, Wyandotte, Michigan,* AND G. P. BREWINGTON, *Lawrence Institute of Technology, Detroit, Michigan.*—A bridge circuit consisting of two multiplier photo-tubes (RCA 931) has been adapted to indicate the ratio of intensities of spectral lines when the tubes are mounted on a spectrograph in place of the photographic film. It has been found that holding the voltage constant on one tube (set on an internal standard line) and varying the voltage applied to the other tube (set on an impurity line), the plot of the logarithm of the concentration of the impurity in the source *vs* the difference of voltage applied to the two tubes is a straight line. Quantitative analyses made using this circuit and calibration method have approached and in some cases equaled the accuracy and sensitivity possible with a photographic plate. Some indication has been obtained that if proper light sources were available the galvanometer reading representing unbalance of the bridge might be of significance for quantitative analyses.

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Pre-Registration Form

At present I expect to attend the meetings of the A. A. P. T. and A. P. S. at State College, Pennsylvania, staying over the night(s) of June 17 yes _____ no _____, June 18 yes _____ no _____, June 19 yes _____ no _____ and to bring my wife yes _____ no _____ and _____ other guests. I wish _____ single, and _____ double rooms to be found for me and enclose check for $1.00 per person to "hold" the room(s).

_____
Name

_____
Address

Mail at once to

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State College, Pennsylvania